551·594·13 : 551·553·21 : 551·578·1 (547)

Electrical Conductivity of Monsoon Rain Water at Poona

V. N. KELKAR

Department of Physics, Nowrosjee Wadia College, Poona

(*Received 22 July 1964*)

ABSTRACT. Electrical conductivity of monsoon rain water was measured at Poona for nine complete rain periods. Conductivity and rate of rainfall vary in opposite phase during the course of a shower indicating that larger raindrops are more dilute than the smaller ones. The average relation between the conductivity and the intensity of precipitation is found to be of the form, conductivity $\propto$ (Intensity)$^{-n}$, where n is a positive constant.

1. Introduction

The electrical conductivity of monsoon rain water has been measured for nine complete rain periods at Poona during the month of July 1961. The showers in August and September were of too short a duration to permit a study of the variation of conductivity with time.

2. Measurements

Rain water was collected in two polythene basins of diameter 26·6 cm each. Samples were collected after an interval of a few minutes depending upon the rate of rainfall. The electrical conductivity was measured immediately after the collection of the samples. A Kohlrausch's bridge with a source of 1000 frequency alternating current was used. The balance point was detected with a sensitive galvanometer and a suitable transistor diode. The cell constant was determined by using N/50 KCl solution at 25°C. The value was found to be 0·22. The volume of water collected was measured with a measuring cylinder after the measurement of conductivity was made. An approximate average value of the intensity of precipitation I in mm/hr has been calculated from the amount of water collected in a known time, taking into account the area of the collecting basins. Table 1 gives the data regarding the date, time of collection, intensity of precipitation and the specific conductivity for all the nine rain periods for which measurements have been made. Data regarding wind speed in km per hour and direction, type and amount of cloud at a time nearest to the time of observations has also been given.

3. Results

The intensity of precipitation as well as the electrical conductivity of rain water were plotted against time. The intensity of precipitation generally fluctuated with time showing many maxima and minima. The electrical conductivity also showed variation with time but the maxima and minima were almost always opposite in phase with the intensity. The conductivity-time curve was a kind of mirror image of the intensity-time curve, showing that conductivity decreases with increase of intensity and *vice versa*. Since the size of the raindrops as a rule increases with the intensity of rain, it appears that large raindrops are more dilute than the small ones. Fig. 1 gives a sample record of the variation of the intensity of precipitation and the electrical conductivity with time for the rain period between 1455–1710 hrs on 5 July 1961.

The electrical conductivity k was plotted against the corresponding intensity of preeipitation I on a double log scale for each of the nine rain periods. A scatter diagram is obtained in each case to which a straight line could always be fitted (Fig. 2). An average relation of the form $k = k_0 \ I^{-n}$, where n is a positive constant, is

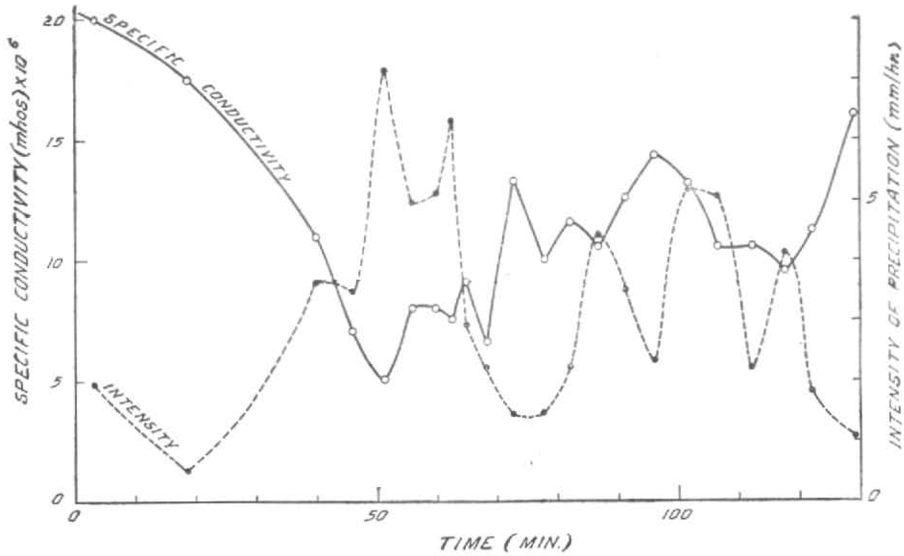

Fig. 1. Variation of the intensity of precipitation and electrical conductivity with time observed on 5 July 1961

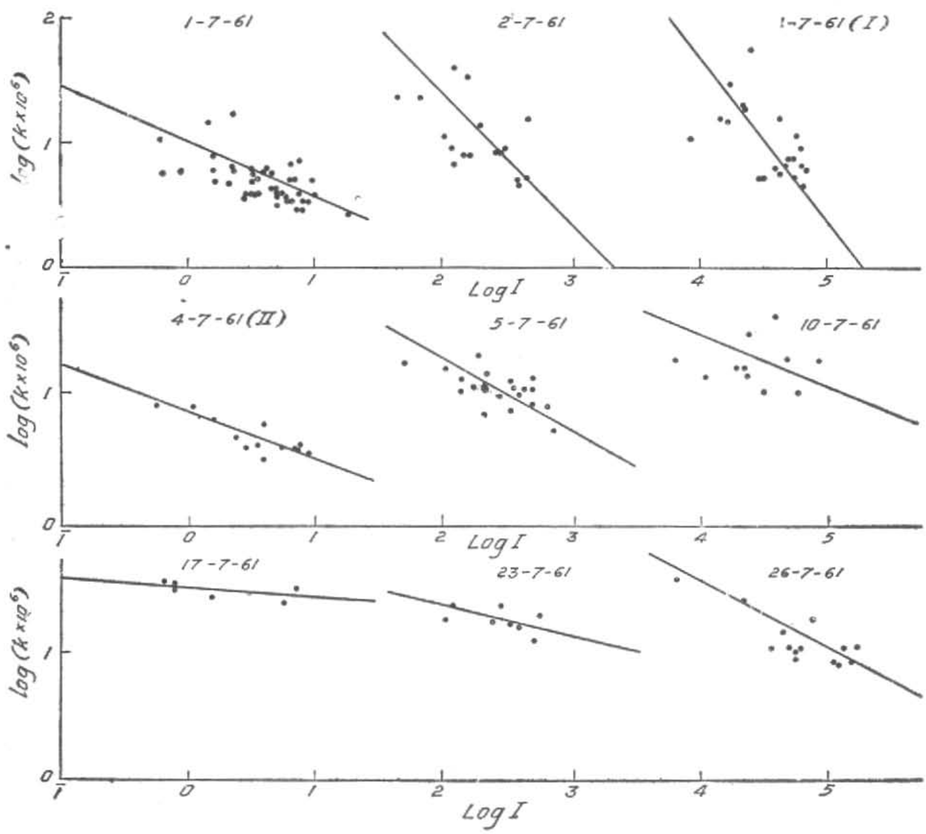

Fig. 2. Variation of electrical conductivity with intensity of precipitation

TABLE 1

Collected during (IST)	Interval (min)	Mean rate of rainfall (mm/hr)	Sp. Conductivity (mhos)×10^6
1 JULY 1961			
0700—0710	10	2·20	18·5
0710—0718	8	7·43	7·4
0718—0725	7	4·10	6·1
0725—0731	6	2·20	6·4
0731—0737	6	4·95	7·7
0737—0744	7	3·14	6·3
0744—0750	6	6·80	5·1
0750—0757	7	9·42	5·0
0757—0804	7	6·45	6·9
0804—0811	7	7·37	4·0
0811—0818	7	3·30	3·9
0818—0828	10	2·86	3·9
0828—0839	11	5·50	4·0
0839—0847	8	5·77	3·4
0847—0856	9	2·80	3·8
0856—0905	9	5·12	3·1
0905—0913	8	2·90	3·7
0913—0941	28	0·63	5·8
0941—0957	16	3·40	6·3
0957—1005	8	3·40	3·9
1005—1015	10	2·10	4·7
1015—1034	19	1·66	4·9
1034—1040	6	5·70	3·7
1040—1046	6	8·80	3·4
1046—1049	3	19·0	2·7
1049—1054	5	8·15	3·5
1054—1057	3	8·00	2·8
(Wind—calm, Clouds 4/8 *Fs*, 4/8 *Ns* at 0830 hrs)			
*1204-1222	18	4·4	5·7
1222—1235	13	3·0	4·0

TABLE 1 (*contd*)

Collected during (IST)	Interval (min)	Mean rate of rainfall (mm/hr)	Sp. Conductivity (mhos)×10^6
1 JULY 1961 (*contd*)			
1235—1241	6	9·9	3·8
1241—1248	7	5·95	3·5
1248—1255	7	5·00	4·0
1255—1320	25	7·30	2·9
1320—1326	6	4·40	4·5
1326—1333	7	3·14	4·8
1333—1340	7	3·14	5·7
1340—1351	11	1·60	6·0
1351—1406	15	0·88	6·0
1406—1433	27	0·60	10·7
1433—1500	27	1·46	14·9
1500—1526	26	1·57	8·0
1526—1539	13	3·40	5·3
1539—1550	11	4·80	4·5
1550—1605	15	3·80	5·9
1605—1610	5	6·40	5·2
1610—1618	8	2·20	6·0
(Wind — SW-6; Clouds 5/8 *Fs*, 3/8 *Ns* at 1730 hrs)			
2 JULY 1961			
1129—1134	5	4·63	16·2
1134—1140	6	3·11	9·1
1140—1151	11	1·20	9·3
1151—1205	14	1·50	8·1
1205—1217	12	1·65	7·9
1217—1230	13	1·02	11·5
1230—1237	7	3·04	8·6
1237—1242	5	4·40	5·1
1242—1247	5	3·96	4·7
1247—1252	5	4·60	5·2
1252—1304	12	1·29	6·9
1304—1330	26	2·70	8·8
1330—1400	30	0·44	23·5

*Between 1057-1204, observations were interrupted on account of official duties, but the rain was continuous

TABLE 1 (*contd*)

Collected during (IST)	Interval (min)	Mean rate of rainfall (mm/hr)	Sp. Conductivity (mhos) × 10⁶
1400—1410	10	1·65	33·7
1410—1420	10	1·98	14·2
1420—1440	20	0·66	23·0
1440—1453	13	1·26	40·0
(Wind — SW-6, Clouds 4/8 *Fs*, 4/8 *As* at 1130 hrs)			
4 JULY 1961			
1329—1338	9	2·58	58·0
1338—1346	8	1·71	30·4
1346—1352	6	2·30	18·7
1352—1358	6	2·20	20·0
1358—1412	14	1·41	15·7
1412—1427	15	1·65	15·0
1427—1432	5	5·50	7·6
1432—1436	4	5·65	5·4
1436—1440	4	4·40	5·8
1440—1444	4	6·46	4·7
1444—1447	3	4·00	6·3
1447—1453	6	5·05	7·5
1453—1457	4	4·40	15·8
1457—1500	3	5·90	11·4
1500—1504	4	6·90	6·2
1504—1507	3	6·20	9·1
1507—1511	4	5·20	7·5
1511—1514	3	6·45	6·9
1514—1517	3	4·80	6·8
1517—1521	4	3·16	5·3
1521—1525	4	2·98	5·3
1525—1535	10	0·83	11·0
(Wind — SW-13, Clouds 2/8 *Sc*, 3/8 *Fs*, 2/8 *As* at 1130 hrs)			

TABLE 1 (*contd*)

Collected during (IST)	Interval (min)	Mean rate of rainfall (mm/hr)	Sp. Conductivity (mhos) × 10⁶
4 JULY 1961 (*contd*)			
1548—1633	45	1·10	7·5
1633—1640	7	3·50	4·0
1640—1644	4	7·60	4·0
1644—1648	4	2·34	4·5
1648—1652	4	9·10	3·4
1652—1656	4	6·90	3·7
1656—1700	4	7·30	3·6
1700—1704	4	3·72	3·0
1704—1708	4	3·84	5·6
1708—1712	4	5·35	3·8
1712—1716	4	5·23	3·7
1716—1721	5	2·86	3·8
1721—1726	5	1·54	6·0
1726—1745	19	0·58	7·6
(Wind — SW-16, Clouds 3/8 *Fs*, 5/8 *Ns* at 1730 hrs)			
5 JULY 1961			
1455—1501	6	1·93	20·0
1501—1532	31	0·51	17·4
1532—1537	5	3·63	10·9
1537—1544	7	3·46	7·0
1544—1548	4	7·15	5·0
1548—1553	5	4·95	8·0
1553—1556	3	5·10	7·9
1556—1558	2	6·30	7·5
1558—1601	3	2·90	9·1
1601—1605	4	2·20	6·6
1605—1610	5	1·43	13·2
1610—1615	5	1·43	10·0
1615—1620	5	2·20	11·5
1620—1625	5	4·40	10·5

TABLE 1 *(contd)*

Collected during (IST)	Interval (min)	Mean rate or rainfall (mm/hr)	Sp. Conductivity (mhos)×10^6
5 JULY 1961 *(contd)*			
1625—1629	4	3·48	12·6
1629—1635	6	2·30	14·3
1635—1640	5	5·15	13·1
1640—1645	5	5·05	10·5
1645—1651	6	2·20	10·5
1651—1656	5	4·07	9·6
1656—1700	4	1·79	11·2
1700—1710	10	1·05	16·0
(Wind — calm, Clouds 4/8 *Fs*, 4/8 *Ns* at 1130 hrs)			
10 JULY 1961			
0832—0838	6	3·96	41·0
0838—0845	7	2·41	29·6
0845—0851	6	1·87	15·9
0851—0901	10	2·26	15·7
0901—0911	10	1·10	13·8
0911—0926	15	0·61	18·3
0926—0932	6	3·20	10·1
0932—0935	3	5·85	10·0
0935—0939	4	2·34	14·0
0939—0949	10	0·88	18·0
0949—1004	15	0·48	18·8
(Wind — SW-6, Clouds 3/8 *Fs*, 5/8 *As* at 0830 hrs)			
17 JULY 1961			
1504—1507	3	5·90	88·0
1507—1513	6	7·00	32·6
1513—1516	3	5·67	24·3
1516—1520	4	1·50	27·5
1520—1530	10	0·83	34·4
1530—1540	10	0·77	31·6
1540—1550	10	0·66	35·6
(Wind — SW-6, Clouds 2/8 *Fs*, 6/8 *As* at 1130 hrs)			

TABLE 1 *(contd)*

Collected during (IST)	Interval (min)	Mean rate or rainfall (mm/hr)	Sp. Conductivity (mhos)×10^6
23 JULY 1961			
1400—1407	7	2·92	23·0
1407—1414	7	2·66	17·3
1414—1416	2	5·20	12·3
1416—1418	2	3·85	15·6
1418—1422	4	3·44	16·7
1422—1425	3	5·50	19·5
1425—1435	10	1·22	23·0
1435—1445	10	1·05	18·0
(Wind — W-3, Clouds 3/8 *Fs*, 5/8 *As* at 1130 hrs)			
26 JULY 1961			
0652—0734	42	0·62	38·6
0734—0740	6	2·20	25·2
0740—0745	5	2·20	23·9
0745—0747	2	6·90	18·0
0747—0750	3	4·56	14·3
0750—0752	2	13·70	10·4
0752—0754	2	17·80	10·9
0754—0756	2	12·6	8·0
0756—0758	2	16·0	8·8
0758—0800	2	11·5	8·5
0800—0802	2	6·05	10·4
0802—0804	2	6·05	11·2
0804—0808	4	5·80	10·0
0808—0811	3	5·50	9·0
0811—0815	4	4·95	10·6
0815—0820	5	6·15	11·0
0820—0840	20	3·62	10·5
(Wind — SW-3, Clouds 4/8 *Fs*, 4/8 *As* at 0830 hrs)			

TABLE 2

Date (July 1961)	k_0 (mhos)$\times 10^6$	n
1	10·0	0·43
2	23·7	1·05
4	46·8	1·29
4	7·1	0·35
5	19·0	0·60
10	29·5	0·41
17	33·9	0·13
23	22·9	0·24
26	35·5	0·50

obtained in all cases. The values of the constants k_0 and n are given in Table 2. The values of n generally lie between 0·13 and 0·60 but on two occasions, *viz.*, 2 and 4 July 1961, n has the abnormally large values 1·05 and 1·29 respectively. Mukherjee (1958) has found that n lies betwen 0·23 and 0·43.

It has been observed that (1) the conductivity has a high value at the beginning of a shower and always decreases in the initial phase and (2) the conductivity always increases in the final phase of a shower.

REFERENCE

Mukherjee, A. K. 1958 *Indian J. Met. Geophys.*, 9, 1, pp. 67-71.